RESEARCH ARTICLE

ISSN: 0331 - 670X

https://doi.org/10.51412/psnnjp.2022.26

The Nigerian Journal of PHARMACY

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Assessment of unsafe disposal of unused and expired medicines practices among households in North-west Nigeria.

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ARTICLE INFO

Article history:

Received 1 June 2022
Revised 14 July 2022
Accepted 23 July 2022
Online Published 30 October 2022

Keywords:

Unused Medicines,
Expired medicines,
Medicines Waste,
Unsafe Disposal,
Eco-pharmacovigilance,
Return Unused Medicines

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ABSTRACT

Background: Unsafe disposal of unwanted medicines continues to be of global concern. Data on such disposal practices among households and the availability of national drug disposal programmes are limited in Nigeria. This study was carried out to assess the practice of unsafe disposal of unused and expired medicines in north-west Nigeria.

Methods: This was a cross-sectional study with participants recruited into the study using an online survey (via Google Forms®) and face-to-face interviews. A hyperlink to the online questionnaire was shared with the targeted population through emails and social media platforms.

Results: A total of 319 valid responses were included in the analysis, of which 60.2% reported practicing unsafe disposal of unused and expired medications. The most utilized disposal methods were discarding in the domestic dustbin (52.6%), burning (10.6%), toilet sink (9.4%), and water drain (9.4%). Frequently involved medicines were analgesics (32.6%), antibiotics (24.4%), and antimalarials (21.7%). Most of the practice resulted from non-adherence (34.9%), self-medication (23.6%), polypharmacy (23.4%), adverse effects (18.1%), and incidental ingestion by children (9.4%). Participants (86.2%) are aware of the health hazards related to the practice, and (95.3%) were willing to comply with the RUM concept.

Conclusion: Given the high prevalence of unsafe disposal practices of unused and expired medicines in the community vis-à-vis their ecotoxicological implications, a spontaneous review of the current national medicines' disposal regulations jointly by the Federal Ministry of Health and the Federal Ministry of Environment that would include interventions such as Return Unused Medicines is highly recommended.

1. Introduction

Safe disposal of unused and expired medicines is gradually becoming a top public health priority considering the widely recognized negative consequences of irrational use of medicines and their improper disposal [1-3]. The World Health Organization report on medication safety has indicated an alarming global consumption trend of medicines in which up to 50% were considered irrationally prescribed, dispensed or sold [4]. This is particularly obvious in Nigeria, where medicines are easily accessed without prescription from the haphazard drug distribution network sequel to uncoordinated or less stringent regulations [5]. Ultimately, this irrational practice, together with several other reported factors [6], negatively disrupts medicines' life cycle resulting in the infiltration of unused medications in households. Consequently, perpetual possession and storage of unused medicines in homes constitute important risk factors for expiration, accidental ingestion by children, polypharmacy, adverse effects, and dose alteration, and serve as a conduit for medicine waste generation [7].

The ecotoxicological implications of medicines waste generation has been well recognized by some developed countries [8-10], and regulatory mechanisms for fostering safe collation, recycling and/or disposal in an eco-friendly fashion have been instituted accordingly. Schemes such as Drug Take Back [11], Disposal of Unwanted Medicines Properly (DUMP) [12], and National Return of Unwanted Medicines (RUM) [13], are in existence in the United States, New Zealand, and Australia, respectively, to encourage patients to return unwanted medicines to specified collection centres (mainly community pharmacies) for onward disposal through appropriate channels. In the United Kingdom, the Disposal of Unwanted Medicines Service Specification was published since 2004, whereby pharmacies are obliged to accept returned unwanted medicines from patients for further sorting before disposal by waste contractors [14].

In Nigeria, a few studies have been conducted in some regions on the disposal of unused, unwanted, and expired medicines. However, national programmes for the collation and disposal of these medicines are lacking. A study conducted in the North-central region of Nigeria reported that 94.1% of households had unused medicines [15]. Another study in the South-eastern part of the country reported poor compliance with disposal practices of expired and unused medications among community pharmacies [7]. However, there is no data on the unsafe disposal of medicines from the North-western region of Nigeria. North-western Nigeria is the most populous geopolitical zone with many open-drug markets and a high rate of self-medication [16]. Therefore, this study aimed to investigate, for the first time, the practice of unsafe disposal of unused and expired medicines in North-western Nigerian households. The study further assessed the population's willingness to comply with a proposed medicine disposal initiative, 'Return Unwanted Medicines' (RUM) programme- an intervention where participants are to return unused medicines to selected registered pharmacies for safe disposal.

2. Methods

The study was conducted and reported based on the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement [17].

2.1 Study Design/Settings/Population

The present study was a cross-sectional conducted in the north-western geographical region of Nigeria. The region is predominantly Hausa/Fulani speaking with a population estimated at around 48 million based on a 2016 report by the National Bureau of Statistics [18]. The two largest open-drug markets in the North (Sabon Gari, Kano and Warri Street, Kaduna) are also located in the sub-region. Participants were eligible if they were ≥ 18 years and residing in North-west Nigeria at the time of the survey.

2.2 Sample size determination

The target population was adults (aged ≥ 18 years) from households in Nigeria's North-western region. We determined the minimum sample size for inclusion in the study using a single proportion formula [19]. We adopted a 94.1% proportion of unused medicines disposal in Nigerian households from a previous study [15]. Assuming a confidence level of 95%, a margin of error (Δ) of 0.5%, and a z value of 1.96, a minimum sample size of 86 was calculated based on the formula below (Equation 1) [19]:

$$n = \left(\frac{z}{\Delta}\right)^2 p(1-p)$$

2.3 Recruitment of respondents

Target respondents from the households were recruited into the study using two survey formats: an online survey (via Google® Forms) and face-to-face interviews using a paper-based questionnaire. This approach was employed to improve the survey coverage and address selection bias.

For the online format, the survey was created using Google® Forms [20]. The survey advertisement contained an invitation to participate and information about the study. The advertisement was shared with the target participants through direct personal contacts and group social media accounts (such as WhatsApp® and Facebook®). Participants could share the advertisement with their friends or make comments on the Facebook advertisement.

Eligible respondents could assess the survey by clicking on a hyperlink that directs them to the Google Form. The form contained study information, objectives, eligibility criteria, consent to participate, and a link to the questionnaire. In this study, consent was implied by submitting the survey. To ensure the recruitment of eligible participants via the online survey, respondents were clearly asked to respond if they were residing in North-west Nigeria. Face-to-face interviews were employed with respondents from households who do not have social media accounts. These participants were recruited from Kano and Kaduna States, the two most populous states in the region. The respondents from the households were selected based on convenience sampling. Face-to-face interviews were conducted following consent and explanation of the study. The recruitment was open between September to November 2019.

2.4 Data collection instrument

The online survey format was designed and reported based on the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) [21]. The questionnaire consists of sub-sections related to; demographic data, type of unused and expired medicines, disposal practices, knowledge of potential health risks of improper medicine disposal to the community, and willingness to comply with the RUM concepts. None of the items was made mandatory for the respondents to answer. Specifically, the following information was collected from the participants: age, gender, years of experience, area of practice, and data related to unsafe disposal of unused medicines in households.

The questionnaire was adopted and modified from previous studies [22-25]. To ensure face validity, the draft questionnaire items were presented to a panel of experts consisting of ten members. The panel was asked to review the items and provide feedback regarding only wording, relevance for study objectives, and target respondents. The questionnaire was revised based on the feedback received from the panel. The questionnaire was then translated into the Hausa language (the predominant local language) by an expert from a translation centre, the Centre of Nigerian Languages, Translation, and Folklore (CNLTF), Bayero University, Kano. The questionnaire was translated using forward and backward translation based on the recommendation of Tsang and his colleagues [26]. The two versions of the questionnaire (English and Hausa languages) were pilot tested among a convenience sample of (10) households with different educational backgrounds. This pilot study aimed to ensure the target respondents understand the items in the questionnaire and identify ambiguous and misleading terms. The questionnaire was updated based on the outcomes of the pilot study, and the items that appeared unclear were reworded to ensure clarity.

2.4.1 Outcome Measures

The prevalence of disposal of unused and expired medicines was assessed by asking the participants, "Do you keep unused or expired medicines in your house or place of work?" The prevalence was calculated by dividing the number of participants who responded with "yes" by the total number of participants. The prevalence was presented as a percentage, with a 95% confidence interval (CI). The CI was determined using the formula by Newcombe [27].

2.5 Statistical analysis

Statistical analysis was conducted using Statistical Package for Social Sciences (SPSS) [28]. For the online survey, the responses were exported from the Google Form into Microsoft Excel and then to the SPSS software. Data were presented as frequency and percentages. Numerical data were presented as mean, standard deviation (SD) or median, depending on the data's distribution. The online survey completion rate was determined by dividing the number of completed responses by the total number of online responses. In contrast, the paper-based survey response rate was computed by dividing the number of returned questionnaires by the total number of distributed questionnaires.

2.6 Ethical considerations

Ethical approval was obtained from the College of Health Science's Research Ethics Committee of Bayero University, Kano, Nigeria (BUK/CHS/REC/71). All survey responses were anonymous to the investigators, and respondents were ensured that participation was solely voluntary, and consent was sought before inclusion.

1. Results

A total of 377 participants were recruited for this survey. Among these participants, 277 (73.5%) were recruited via the online format, while 100 (26.5%) were through the paper-based format. About 51 (13.5%) of the recruited target participants did not respond to the survey, while 7 (5.7%) started the survey but were found to be not eligible due to being underage (<18 years). A total of 319 (84.6%) eligible participants who submitted the surveys were included in the study. The online survey completion rate was 99.6%, and the response for the paper-based survey was 50%. The recruitment process is shown in Figure 1.

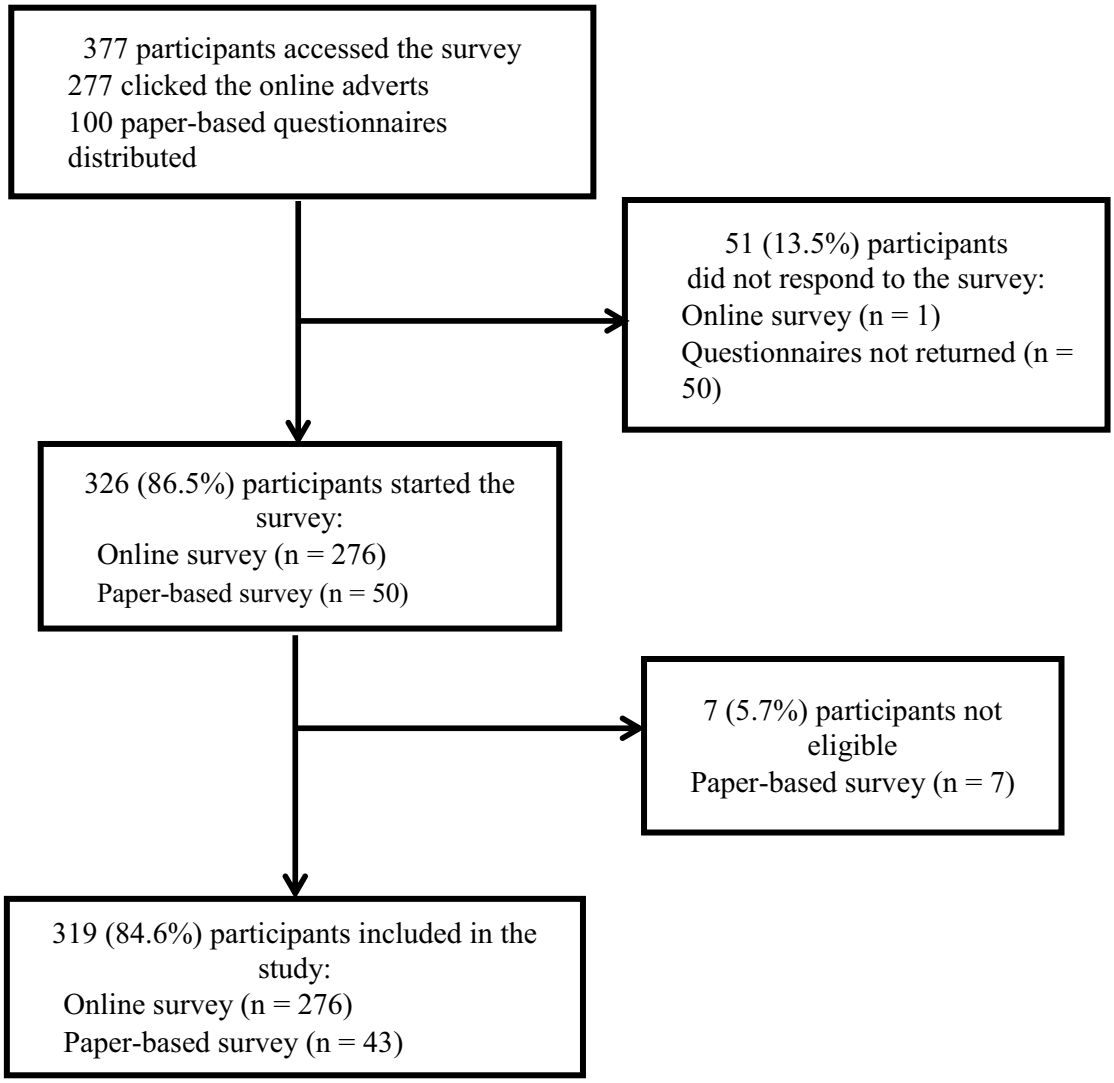

Figure 1: Flowchart of the recruitment process of the participants.

3.1 Socio-demographic Characteristics of the Participants

The mean ±SD age of the participants was 31.8 ±8.5. The oldest participant was 63 years old. Most respondents were males (61.0%) and from rural areas (87.7%). Also, 31% reported having a previous medical condition, with most having cardiovascular disorders (33.7%), diabetes (18.9%), malaria/typhoid (12.4%), and asthma/bronchitis (7.7%). The socio-demographic characteristics of the participants are provided in Table 1.

Table 1: Socio-demographic characteristics of the participants

Variable		Mean ± SD	Frequency (%)
Age		31.8 ± 8.5	
Gender	Male		194 (60.8)
	Female		125 (39.2)
Residential area	Urban		279 (87.5)
	Rural		40 (12.5)
Employment status	Yes		238 (74.6)
	No		81 (25.4)
Place of work	University		53 (16.6)
	Hospital		62 (19.4)
	Civil servant		45 (14.1)
	Private sector		51 (15.9)
	Housewife		22 (6.9)
	Retired		2 (0.6)
	Businessman		14 (4.4)
	Others		70 (21.9)
History of Medical condition	Yes		90 (31.0)
	No		229 (68.9)
Disease condition *	Malaria/typhoid		21 (12.4)
	CVS disorders		57 (33.7)
	Diabetes		32 (18.9)
	Asthma/Bronchitis		13 (7.7)
	Others		46 (27.3)

SD, Standard deviation; * values may add to more than 100% due to multiple options; CVS: Cardiovascular disorders

3.2 Prevalence of Disposal of Unused or Expired Medicines

When participants were asked, "Do you keep unused or expired medicines in your house or place of work?" 192 responded with "yes" and 125 replied with "no". The prevalence was calculated to be 60.2% (95% CI, 54.7 to 65.4). Of these participants, 19.4% and 67.4% have reported that they always keep unused and expired medicines and sometimes, respectively. At least 30 (9.3%) of the participants have reported accidental ingestion of unused and expired medication by children.

The most commonly unused and expired drugs disposed of by the participants were analgesics (32.6%), antibiotics (24.4%), antimalarials (21.7%), and antiulcer medicines (11.9%). Other medications, such as antiretrovirals, eye drops, and supplements, constituted only 1.5% of unused and expired drugs (Table 2).

Table 2. Attitudes and Practices of keeping unused and expired medicines disposal

Variables	Frequency (%)
How often does respondents keep unused/expired medicines?	
Always	19.4
Sometimes	67.4
Not applicable	13.2
Circumstances under which unused/expired medicines were obtained	
Obtained without prescription	23.6
Prescribed in excess	23.4
Discontinued due to side-effects	18.1
Discontinued due to better prognosis	34.9
Class of unused/expired medicines	
Pain relief medication	32.6
Antibiotics	24.4
Antimalarials	21.7
Hypertension or diabetes medicines	7.9
Peptic ulcer medicines	11.9
Others	1.5
Accidental ingestion by children	
Yes	9.4
No	80.6
Not sure	10.0

3.3 Sources Where the Participants Obtained Medicines

The participants who practiced unsafe disposal of unused and expired medicines obtained the medicines predominantly as a leftover of discontinued treatment sequel to better prognosis (34.9%) and adverse events (18.1%). Polypharmacy (23.4%) and obtaining medicines without prescription (23.6%) from pharmacies and/or patent medicine stores.

3.4 Methods of Disposal of Unused and Expired Medicines

Discarding in the dustbin/garbage was the major method of disposal (52.6%), followed by flushing down the drain, and inside, the toilet sinks 9.4% each. Returning medicines to the pharmacy and/or medical stores (7.9%) and giving to another person (7.4%) were other routes through which medicines were disposed. Only 2.7% reported that they hardly dispose of medications (Figure 2).

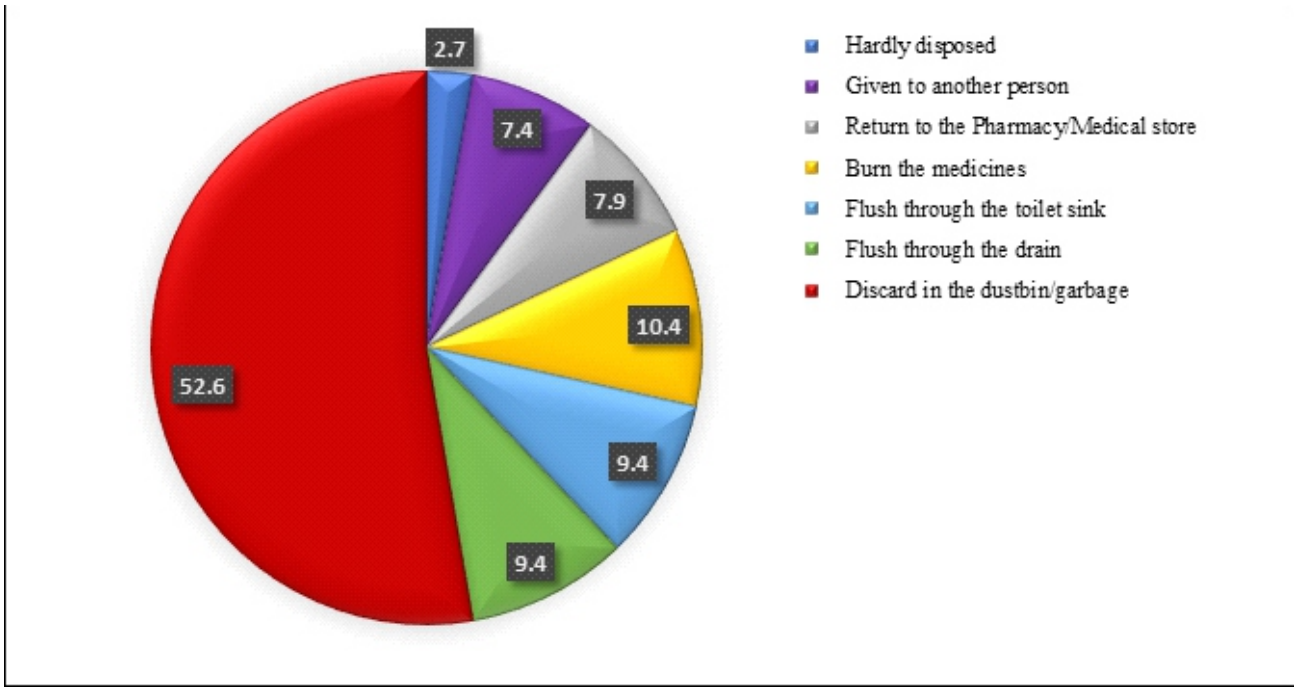

Figure 2: Methods of disposal of unused and expired medicines among households in northern Nigeria.

The routes through which unused and expired medicines are disposed into the environment were determined by evaluating the general domestic waste disposal practices. Most participants (48.5%) reported that their domestic waste is disposed of using collection bins and authorized dump sites (27.2%). Dumping at unauthorized sites and burning wastes inside or around residential areas accounted for 10.4% and 7.6% of responses, respectively. Some participants (4.7%) did not know how their domestic waste is disposed of.

3.5 Knowledge of Appropriate Disposal of Unused and Expired medicines

Most of the respondents (13.5%) obtained knowledge about the disposal of unused and expired medicines from healthcare professionals, schools (11.5%), family members, and friends (7.3%). Patient information leaflets (9.0%), awareness campaigns by an environmental agency (18.8%), social media (2.5%), television, and radio programmes (2.5%) were other sources where participants obtained information about the disposal of medicines. Notably, 48.5% of the participants used their discretion to decide the best method to dispose of medications.

Most of the participants (86.2%) considered improper disposal practices as harmful to the environment, harmful to water sources (39.4%), domestic animals (21.2%), and air pollution (21.2%). When participants were asked if they have ever received any guidance regarding the appropriate disposal of medicines, 118 (36.9%) said yes.

3.6 Willingness to Participate in the Return Unused Medicines Program (RUM)

Of the total participants, 304 (95.3%) responded that they are willing to participate in the future initiative, "Return Unused Medicines (RUM)", while the remaining 15 (4.7%) declined.

4. Discussion

We report the first study assessing the disposal of unused medicines in the north-western region of Nigeria. We found that more than half of the households in the north-western region of Nigeria unsafely dispose of unused or expired medicines (Prevalence, 60.2%; 95% CI, 54.7 to 65.4). Most of the participants dispose of medicines in dustbins, and the majority obtained knowledge about safe disposal from healthcare professionals. We also found that more than 90% of participants were willing to participate in a RUM program. Given the participants' readiness to participate in the future RUM program, interventions to improve unused medicines' safe disposal are likely to be successful.

This study found that most people keep unused medicines at home. This finding is consistent with evidence from other studies conducted in African [29,30]; Asian [31,32]; Middle-Eastern [33,34]; New Zealand [35] and European countries [36,37]. There is a need to avoid this practice because unwarranted and uncontrolled stocking of medicines in homes were implicated as sources of potential health threats to individuals, society, and the ecosystem [38-41]. Circumstances stated by our study participants for having unused medicines mostly include obtaining drugs without prescriptions, excess prescription, and discontinuation due to side effects or better prognosis. Discontinuation of therapy on a perceived cure by patients has been reported [42,43]. The common practice of abrupt discontinuation of medications suggests the lack of awareness of the importance of completing a treatment course among the public and potentially predisposes to keeping unused medications in households.

Our study also reported participants using their discretion in discarding unused medicines mostly into dustbins/garbage, with few reported returning to the pharmacy/medical store. Our study was consistent with previous studies that reported throwing away unused medicines into household trash bins and fewer returning to the pharmacies/collection centres [23-25]. In contrast, other studies from Sweden [44], Malaysia [31] and Kuwait [33] reported a higher proportion of the participants stating returning unused medicines to the pharmacy as the best disposal method. Our findings could be explained by the lack of comprehensive drug disposal policies and RUM programs in Nigeria. Improving patient education and awareness by healthcare professionals and policymakers on appropriate utilization and disposal of medicines are recommended. Prescribers should improve on acceptable prescribing practices, reducing the stocking of medications at home and improper disposal.

Some participants stated they were not concerned about potential health risks and the environmental impact of improper disposal of unused medicines. Another study reported that most participants were unaware of the consequences of keeping unused medication in homes [23]. In contrast, another study conducted in Ethiopia found that most participants believed unused medicines present potential risks at homes [45]. Of interest, most of the participants in this study believed improper disposal of unused medicine is harmful to the environment, particularly water bodies. This finding provides an opportunity for implementing interventions for improving the appropriate disposal of unused medications at homes.

In our study, most participants do not receive guidance on proper disposal of unused medicines, implying poor knowledge. If they get the direction, they believe it will play a better role in proper disposal practices. Similarly, other previous studies reported that their participants never received advice on medication disposal from any healthcare professional [29,45]. This finding suggests gaps in healthcare professionals' services, mainly the pharmacists and doctors directly involved in delivering the medicines. Hence, all relevant healthcare professionals should offer consistent education regarding the safe use of medication and disposal practices. Training of healthcare professionals could facilitate the successful waste management of pharmaceutical products [46].

There is currently no national guideline or take-back program on the disposal of unused medicines in Nigeria. Our study noted that most participants are willing to participate in the RUM program, if available. The "gold standard" for safe, legal, environmentally sound disposal to put tamper-resistant boxes in pharmacies that allow consumers to bring medicines back was recommended [14]. The Nigerian government needs to be proactive in launching feasible unused medications collection programs (such as the proposed RUM), similar to what is obtainable in other regions of the world: Medications Return Program or Take-back programs in New Zealand, USA, Australia and Europe [12,13,47].

Study Limitations

This study has the following limitations. First, most of the respondents were recruited through the online survey (via social media); this will limit the participation of individuals without internet access. However, we addressed this shortcoming by employing face-to-face interviews, a paper-based questionnaire survey, where 13.5% of included participants were recruited. Secondly, there might

be sampling bias due to the paper-based survey's low response rate, despite sending reminders to the participants. However, the literature suggests a response rate of 60% and above to be acceptable for a survey [48].

5. Conclusion

We report the first study assessing the disposal of unused medicines in the north-western region of Nigeria. We identified a 60.2% prevalence of unsafe disposal of unused and expired medication among adult household respondents in the north-western part of Nigeria. The study identified gaps related to safe household disposal of drugs, and most participants were willing to participate in the future RUM concept. Therefore, interventions such as RUM should be implemented to ensure the community's safe disposal of medicines.

Conflict of Interest

The authors declare that there is no conflict of interest.

Acknowledgement

The authors would like to thank and appreciate the efforts of members of the Pharmacy Scholars Initiative (PSI) for the mentoring, encouragement, and support during all the stages of this study. PSI is a registered mentoring forum for upcoming researchers. The authors also appreciate all respondents and the questionnaire translator from the Centre of Nigerian Languages, Translation, and Folklore (CNLTF), Bayero University, Kano.

References

1. Harhay M, Halpern S, Harhay J, Olliaro P (2009) Health care waste management: a neglected and growing public health problem worldwide *Trop Med Int Health* 14(11): 1414-1417 https://doi.org/10.1111/j.1365-3156.2009.02386.x

2. Paut KM, Tomas A, Horvat O, Tomić Z, Sabo A (2015) Storage and Disposal of Unused Medications: Knowledge, Behavior, and Attitudes Among Serbian People *Clin Ther*. 37:e27-e28 https://doi.org/10.1016/j.clinthera.2015.05.086

3. Tong A, Peake B and Braund R (2011) Disposal practices for unused medications around the world *Environ Int*. 37:292-298 https://doi.org/10.1016/j.envint.2010.10.002

4. World Health Organisation (2019) Medication safety in polypharmacy: technical report https://www.who.int/publications/i/item/medication-safety-in-polypharmacy-technical-report Accessed November 10, 2020

5. Fatokun, O (2016) Curbing the circulation of counterfeit medicines in Nigeria *Lancet* 388(1060):2603 https://doi.org/10.1016/S0140-6736(16)32121-3

6. Makki M, Hassali MA, Awaisu A, Hashmi F (2019) The Prevalence of Unused Medications in Homes *Pharmacy* 7(2):61 https://doi.org/10.3390/pharmacy7020061

7. Michael I, Ogbonna B, Sunday N, Anetoh M, Okonta M (2019) Assessment of disposal practices of expired and unused medications among community pharmacies in Anambra State southeast Nigeria: A mixed study design *J Pharm Policy Pract.* 12(12) https://doi.org/10.1186/s40545-019-0174-1

8. Bound JP, and Voulvoulis N (2005) Household disposal of pharmaceuticals as a pathway for aquatic contamination in the United Kingdom *Environ Health Perspect*. 113(12): 1705–1711 https://doi.org/10.1289/ehp.8315

9. Gunnarsson L, Snape JR, Verbruggen B, Owen SF, Kristiansson E, et al (2019) Pharmacology beyond the patient – The environmental risks of human drugs *Environ Int*. 129: 320–332 https://doi.org/10.1016/j.envint.2019.04.075

10. Persson M, Sabelström E and Gunnarsson B (2009) Handling of unused prescription drugs - knowledge, behaviour and attitude among Swedish people *Environ Int.* 35(5): 771–774 https://doi.org/10.1016/j.envint.2008.10.002

11. US Food & Drug Administration (2020) Drug Disposal: Drug Take Back Locations https://www.fda.gov/drugs/disposal-unused-medicines-what-you-should-know/drug-disposal-drug-take-back-locations Accessed November 10, 2020

12. Braund R, Gn G and Matthews R (2009) Investigating unused medications in New Zealand *Pharmacy world & science* 31(6):664-669 https://doi.org/10.1007/s11096-009-9325-9

13. Wheeler AJ, Spinks J, Bettington E, Kelly F (2017) Evaluation of the national return of unwanted medicines (RUM) program in Australia: A study protocol *J Pharm Policy Pract*. 10: 1–10 https://doi.org/10.1186/s40545-017-0126-6

14. Disposal of unwanted medicines : PSNC Main site (2013) https://psnc.org.uk/services-commissioning/essential-services/disposal-of-unwanted-medicines/ Accessed November 10, 2020

15. Auta A, Omale S, Shalkur D, Abiodun AH (2011)

Unused medicines in Nigerian households: Types and disposal practices *J Pharmacol Pharmacother.* 2(3):195-196 https://doi.org/10.4103/0976-500X.83290
16. Khalid GM, Jatau AI, Ibrahim UI, Dungus FM, Shittu Z, et al (2019) Antibiotics self-medication among undergraduate pharmacy students in Northern Nigeria *Med Access Point Care* 3 https://doi.org/10.1177/2399202619846847
17. Field N, Cohen T, Struelens MJ, Palm D, Cookson B, et al (2014) Strengthening the Reporting of Molecular Epidemiology for Infectious Diseases (STROME-ID): An extension of the STROBE statement *Lancet Infect Dis*. https://doi.org/10.1016/S1473-3099(13)70324-4
18. National Bureau of Statistics (2016) https://www.nigerianstat.gov.ng/ Accessed April 23, 2021
19. Sample Size Calculator (n.d.) https://www.calculator.net/sample-size-calculator.html Accessed November 10, 2020
20. Google Forms: Free Online Surveys for Personal Use (n.d.) http://www.google.com.au/forms/about/ Accessed April 4, 2021
21. Eysenbach G (2004) Improving the quality of web surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES) *J Med Internet Res*. https://doi.org/10.2196/jmir.6.3.e34
22. Kusturica MP, Sabo A, Tomic Z, Horvat O, Solak Z (2012) Storage and disposal of unused medications: Knowledge, behavior, and attitudes among Serbian people *Int J Clin Pharm*. 34: 604–610 https://doi.org/10.1007/s11096-012-9652-0
23. Al-Shareef F, El-Asrar SA, Al-Bakr L, Maisam A, Alqahtani F et al (2016) Investigating the disposal of expired and unused medication in Riyadh, Saudi Arabia: a cross-sectional study *Int J Clin Pharm.* 38: 822–828 https://doi.org/10.1007/s11096-016-0287-4
24. Bashaar M, Thawani V, Hassali MA, Saleem F (2017) Disposal practices of unused and expired pharmaceuticals among general public in Kabul *BMC Public Health* 17(1) https://doi.org/10.1186/s12889-016-3975-z
25. Manocha S, Suranagi UD, Sah RK, Chandane AD, Kulhare S, et al (2019) Current Disposal Practices of Unused and Expired Medicines Among General Public in Delhi and National Capital Region, India *Curr Drug Saf.* 15: 13–19 https://doi.org/10.2174/1574886314666191008095344
26. Tsang S, Royse CF and Terkawi AS (2017) Guidelines for developing, translating, and validating a questionnaire in perioperative and pain medicine *Saudi J Anaesth*. 11(5):80-89 https://doi.org/10.4103/sja.SJA_203_17
27. Newcombe RG (1998) Two-sided confidence intervals for the single proportion: Comparison of seven methods. *Stat Med.* 17:857–872 https://doi.org/10.1002/(SICI)1097-0258(19980430)17:8<857::AID-SIM777>3.0.CO;2-E
28. IBM Corp (2011) IBM SPSS Statistics for Windows. 20. New York: IBM Corp.
29. Angi'enda SA and Bukachi SA (2016) Household Knowledge and Perceptions on Disposal Practices of Unused Medicines in Kenya *Journal of Anthropology and Archaeology* 4(2) https://doi.org/10.15640/jaa.v4n2a1
30. Ayele Y and Mamu M (2018) Assessment of knowledge, attitude and practice towards disposal of unused and expired pharmaceuticals among community in Harar city, Eastern Ethiopia *J Pharm Policy Pract.* 11(1) https://doi.org/10.1186/s40545-018-0155-9
31. Al-Naggar RA and Alareefi A (2010) Patients opinion and practice toward unused medication disposal in malaysia: A qualitative study *Thai Journal of Pharmaceutical Sciences* 34:117-123
32. Azad A, Ansary R, Akhter A, Al-Mamun SM, Uddin M, et al (2012) Disposal practice for unused medications among the students of the International Islamic University Malaysia *J Appl Pharm Sci.* 2: 11 http://dx.doi.org/10.7324/JAPS.2012.2712
33. Abahussain EA, Ball DE and Matowe WC (2006) Practice and opinion towards disposal of unused medication in Kuwait *Medical Principles and Practice*. 15: 352–357 https://doi.org/10.1159/000094268
34. Al-Shareef F, El-Asrar SA, Al-Bakr L, Al-Amro M, Alqahtani F, et al (2016) Investigating the disposal of expired and unused medication in Riyadh, Saudi Arabia: a cross-sectional study *Int J Clin Pharm.* 38: 822–828 https://doi.org/10.1007/s11096-016-0287-4
35. Braund R, Peake BM and Shieffelbien L (2009) Disposal practices for unused medications in New Zealand *Environ Int*. 35: 952–955 https://doi.org/10.1016/j.envint.2009.04.003
36. Persson M, Sabelström E and Gunnarsson B (2009) Handling of unused prescription drugs - knowledge, behaviour and attitude among Swedish people *Environ Int*. 35: 771–774 https://doi.org/10.1016/j.envint.2008.10.002
37. Vellinga A, Cormican S, Driscoll J, Furey M, O'Sullivan M, et al (2014) Public practice regarding disposal of unused medicines in Ireland *Sci Total Environ* 478: 98–102 https://doi.org/10.1016/j.scitotenv.2014.01.085

38. Costanzo SD, Murby J and Bates J (2005) Ecosystem response to antibiotics entering the aquatic environment *Mar Pollut Bull* 218–223 https://doi.org/10.1016/j.marpolbul.2004.10.038
39. Jobling S, Williams R, Johnson A, Taylor A, Gross-Sorokin M, et al (2006) Predicted exposures to steroid estrogens in U.K. Rivers correlate with widespread sexual disruption in wild fish populations *Environ Health Perspect* 114: 32-39 https://doi.org/10.1289/ehp.8050
40. Kümmerer K (2009) The presence of pharmaceuticals in the environment due to human use - present knowledge and future challenges *J Environ Manage* https://doi.org/10.1016/j.jenvman.2009.01.023
41. Rogowska J, Zimmermann A, Muszyńska A, Ratajczyk W, Wolska L (2019) Pharmaceutical Household Waste Practices: Preliminary Findings from a Case Study in Poland *Environ Manage* 64: 97-106 https://doi.org/10.1007/s00267-019-01174-7
42. Nantz E, Liu-Seifert H and Skljarevski V (2009) Predictors of premature discontinuation of treatment in multiple disease states *Patient Prefer Adherence* 3: 31-43 https://doi.org/10.2147/PPA.S4633
43. de Climens AR, Pain E, Boss A and Shaunik A (2020) Understanding Reasons for Treatment Discontinuation, Attitudes and Education Needs among People Who Discontinue Type 2 Diabetes Treatment: Results from an Online Patient Survey in the USA and UK *Diabetes Therapy* 11: 1873–1881 https://doi.org/10.1007/s13300-020-00843-9
44. Wettermark B, Bergman U and Krakau I (2006) Using aggregate data on dispensed drugs to evaluate the quality of prescribing in urban primary health care in Sweden *Public Health* 120: 451–461 https://doi.org/10.1016/j.puhe.2005.10.011
45. Kassahun H and Tesfaye D (2020) Disposal Practices of Unused Medications Among Patients in Public Health Centers of Dessie Town, Northeast Ethiopia: A Cross Sectional Survey *Integr Pharm Res Pract* 9: 65-70 https://doi.org/10.2147/iprp.s243069
46. Oyekale AS and Oyekale TO (2017) Healthcare waste management practices and safety indicators in Nigeria *BMC Public Health* 17: 740 https://doi.org/10.1186/s12889-017-4794-6
47. Ekedahl ABE (2006) Reasons why medicines are returned to Swedish pharmacies unused *Pharm World Sci* 28: 352–358 https://doi.org/10.1007/s11096-006-9055-1
48. Fincham JE (2008) Response rates and responsiveness for surveys, standards, and the Journal *Am J Pharm Educ* https://doi.org/10.5688/aj720243